SOIL SURVEY OF MONTGOMERY COUNTY, OHIO.

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INTRODUCTION.

Montgomery County is situated in the southwestern corner of Ohio (see fig. 3) and covers an area of 480 square miles, or 307,200 acres. It lies between 39° 36′ and 39° 56′ north latitude and 84° 4′ and 84° 29′ west

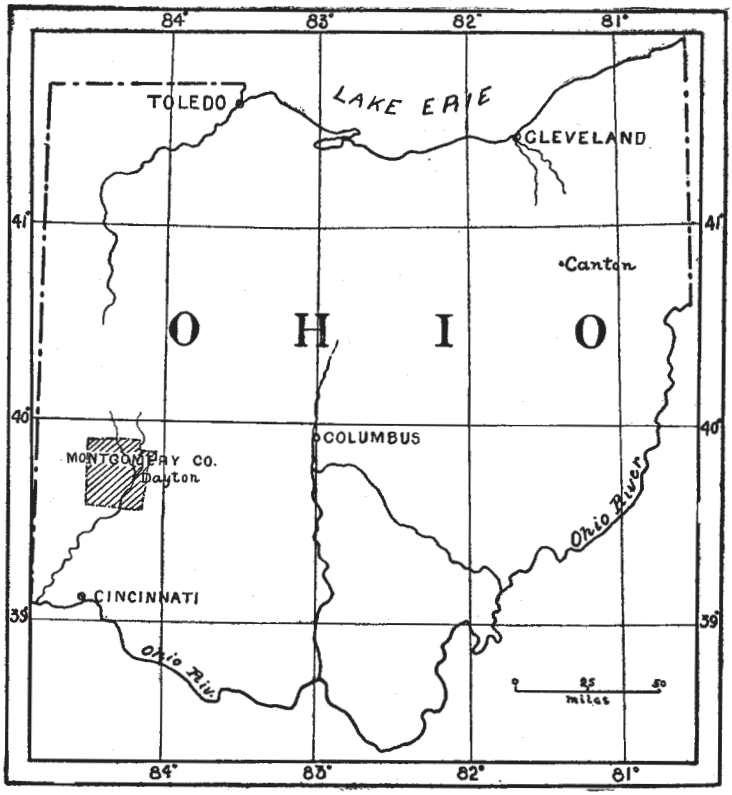


FIG. 3.—Sketch map of Ohio, showing position of Montgomery County and area surveyed.

longitude. The greatest length of the county is 23 miles, while the width in the northern part of the county is about the same. Tobacco is grown in every township in the county and finds a ready market in Dayton, the county seat, one of the flourishing manufacturing cities of Ohio.

PHYSIOGRAPHY.

The surface features partake largely of the general conditions prevailing in the southwestern part of the State, namely: A broad, gently rolling plateau through which the principal streams have carved wide and fertile valleys. The rolling plateau in Montgomery County is traversed by the extensive valleys of the Great Miami, Stillwater, and Mad rivers, as well as by minor valleys along Twin, Bear, and Wolf creeks. The greatest area of these valleys is at the junction of Stillwater and Mad rivers with the Great Miami, where the city of Dayton is located. Here the valley is several miles in width, and consists of a series of well-marked terraces bounded on either side by high, steep hills. The broad terraces are a constant feature of all the river valleys in the county; often as many as five distinct terraces can be observed. Generally, the valleys are inclosed by high hills, but this is not the case north and south of Harshmanville and west of Carrollton. In these two cases the valleys slope imperceptibly into the uplands without any prominent line of demarcation. At Harshmanville the valley floor is 780 feet above sea level, at Miamisburg the river's bed is 266 feet above low water at Cincinnati, or 698 feet above sea level. The Great Miami River falls 100 feet in a distance of 33 miles in traversing the county.

The upland is more or less broken, depending somewhat upon the distance from the larger streams. The upland at one time undoubtedly presented a remarkably even surface, but the small streams have modified this level surface to a considerable extent. Even in the more hilly portions of the county the remains of this once level surface are seen in the perfectly level sky line now attained by the highest hills. In the northern and northwestern part of the county the level character of this old plain is still seen, for the small streams have not as yet carved out deep channels. In Clay, Randolph, and Butler townships the country is very level, and one can see for miles on the straight roads with no distinct change in elevation. The general level of the upland in these townships is about 1,000 feet above sea level and 300 feet above the valley floor at Dayton. This section of the country was originally poorly drained and there were many large swamps, but these have long since been ditched and are now as dry as the more hilly sections of the county.

The southwestern and southeastern parts of the county are hilly and broken, the southwestern corner of German Township being especially hilly. The hills northeast of Germantown are commonly regarded as the highest hills in the county, although they do not rise above the elevation given for the northwestern townships. West of Dayton, where the National Soldiers' Home is located, a rather prominent ridge extends north and south for several miles. In Van Buren and Harrison townships there are prominent gravel hills. The hills bordering the valleys rise from 80 to 150 feet above the valley floors.

The surface of the county slopes gradually to the south, hence all of the drainage is in that direction.

GEOLOGY.

The geology of Montgomery County also partakes largely of the geology of this section of Ohio. The underground geology consists of nearly horizontal beds of upper and lower Silurian shales and limestones. The Upper Silurian is represented by the Niagara and Clinton series. These are found only on the high hilltops of the county, and the total thickness of the two formations rarely exceeds 60 feet. The Niagara consists of limestone and shale. The shale contains a valuable building stone known as the Dayton stone. This consists largely of lime carbonate and is a strong, evenly bedded, compact stone, well suited for building purposes. The Clinton series consists of crinoidal limestones. The Lower Silurian in Montgomery County has been commonly referred to as the Cincinnati group. This formation is the equivalent of the Hudson River shales in the eastern part of the United States, and in this locality is often called "blue limestone." It has a thickness in different parts of the county varying from 150 to 225 feet. The upper layers of this formation are somewhat sandy and serve as a good fire brick or building stone. Fine exposures of these rocks are seen along the small streams where they cut through the steep hills bordering the valleys.

These underground formations rarely outcrop on the surface, for they are generally buried under a thick coating of glacial débris or drift. This drift is composed of a heterogeneous mixture of ground-up rock fragments, containing bowlders, gravel, sand, and clay in varying proportions, deposited over the entire country when a great continental ice sheet covered this section of the United States. The drift on the uplands is called bowlder clay, as it is believed to be actually derived from the grinding up of bowlders. It is the most characteristic of the drift deposits and is now believed to have been formed under extensive ice sheets. The bowlder clay is a stiff clay mixed with angular and rounded gravel, bowlders, and varying amounts of sand. It has not been modified, to any considerable extent, by running water, while the drift found in the valleys shows clearly the assorting agency of swift currents of running water. The drift in the valleys is characterized by a lack of the bowlders, which form so prominent a feature of the uplands. These bowlders have been transported distances varying from a few miles to several hundred miles. They are derived from the bed rock of northwestern Ohio, the Clinton, Niagara, Waterlime, Corniferous, and black slate. Old metamorphosed granites, gneisses, schists, from the shores of Lake Superior and the Canadian highlands, are also represented in the erratic bowlders scattered about over the surface. The deposits of drift materials range from a few feet to over 100 feet in depth. A

general profile of the valley is shown in fig. 4. On many of the hills along the roadways where the deposits of drift have been removed the scratches or grooves made by the ice in passing over the underlying limestones can be distinctly seen. These were made by the hard bowlders which the glacier held imprisoned under the great mass of ice. These scratches always indicate that the ice advanced from the northwest over this part of Ohio.

CLIMATE.

The climate of southwestern Ohio is quite similar to the climate of the central portion of the United States. It is one of considerable extremes, varying from —10° or —15° in cold winters to 100° above zero in hot, dry summers. The extreme annual range of temperature is thus not far from 115°. Although rainfall and temperature records have been kept in Dayton for a number of years, the figures are not so reliable as those given by the regular United States Weather Bureau office at Cincinnati, and the climatological data in the following table are for the latter place. As Cincinnati is not over 35 miles distant from the southern boundary of Montgomery County, there

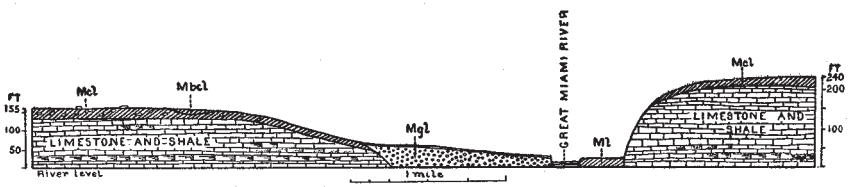


FIG. 4.—Profile across valley of Great Miami River, north of Miamisburg: *Mcl*, Miami clay loam; *Ml*, Miami loam: *Mgl*, Miami gravelly loam; *Mbcl*, Miami black clay loam.

will be but little difference in the normals given and the conditions for Montgomery County.

Climatological data for southwestern Ohio.

Month.	Mean maximum temperature.	Mean minimum temperature.	Mean monthly temperature.	Average monthly rainfall.	Mean relative humidity.
	°F.	°F.	°F.	*Inches.*	*Per cent.*
April	63	45	55	3.3	61
May	74	57	65	4.0	63
June	81	65	74	4.4	65
July	86	69	77	3.9	65
August	84	67	75	3.8	65
September	78	62	68	3.0	69
Annual	63.8	48.9	56	*a* 22.4	69

a Total for six months.

CONDITIONS OF AGRICULTURE.

At the time of the first expedition to this portion of the valley, in the latter part of the eighteenth century, the country was an unbro-

ken forest with the exception of small open prairies and wet, swampy places, the wet places being covered with long, waving grasses. The rich bottom lands were not so heavily timbered as the uplands, but were covered with a tangled mass of vines and weeds and thick underbrush. The prairie lands were few and of small extent. One of these was said to have been located in the bottom lands where Dayton now stands. The black bottom lands were the first to be settled, while the level uplands, much of which was quite swampy, were regarded as poor land and were little sought after.

The first permanent settlements were made in 1795 and 1796, and as early as 1797 it is mentioned, in the old histories, that crops of corn, hemp, flax, beans, turnips, cabbage, and potatoes were raised. Tobacco is also said to have been grown by these early pioneers, but it was probably in limited quantities if, indeed, it was grown at all. In this same year, 1797, a large quantity of maple sugar was made by evaporating the sap of the sugar maples, these trees growing very plentifully on the uplands. Wild grass and corn fodder were used for cattle and horse feed, as clover and timothy hay were unknown in those days. Montgomery County was formed in May, 1803, and since that time a steady advancement has been made along the lines of successful agriculture.

Although but little more than one hundred years have passed since the early settlers planted their first crops, Montgomery County now ranks high in the production of the staple crops, such as wheat, corn, tobacco, oats, rye, and potatoes. There are few large farms in the county, and even these are rapidly being divided. The average farm contains from 100 to 120 acres, of which about 10 or 12 acres still remain uncleared. In the valleys there is comparatively little woodland, but on the uplands, especially on the more level portions, there are long stretches of native forests. While the farms do not command the prices they did a few years ago, owing to the general depreciation in farming districts, they compare favorably with the more prosperous farming sections of Ohio. The farms of the entire county are assessed at $50 per acre, and this represents slightly more than three-fourths of their actual value. A well-improved farm of 160 acres will bring from $60 to $75 per acre, and the best farms will sell for $100 per acre. The improvements on a good farm are rather extensive and include a comfortable dwelling house, large, roomy barn, capable of housing the live stock, with room for the hay and grain crops. Usually there is a tobacco barn or shed and smaller wagon shed, corn cribs, and minor buildings. In all, these buildings have a value of several thousand dollars. The farms are all well fenced with old-fashioned worm fences, board and wire fences, and, in many places, a farm will be completely fenced with neatly trimmed osage-orange hedge fences. The latter, if well cared for, outlast the other fences, are strong, and at the same time add to the attractiveness of the farm surroundings.

While some portions of the county are naturally more fertile and productive and were on this account eagerly sought after by the early settlers, these differences are not so apparent as they formerly were. The whole county is carefully cultivated and in a prosperous condition. This is the case in the northwestern part of the county, even where there were originally many large, swampy tracts of land. The bottom lands produce fine crops of corn, while the clay uplands are adapted to the raising of wheat, tobacco, and corn. The facilities for shipping are good, for there are three main lines of railroad which cross the county, besides other railroads of less importance. There are also a number of well-equipped electric traction roads which lead from Dayton to the county seats of adjoining counties. Free pikes, maintained at the expense of the county, radiate in every direction from Dayton throughout the county. In addition, good gravel roads laid out on section and half-section lines furnish the farmer ample means of communication with the railroads and towns. Across the creeks and rivers are well-built, substantial bridges, maintained at the expense of the county. The city of Dayton also contributes largely to the expense of the larger bridges and the more important pikes.

The tobacco industry was first developed largely on the rich soils of the broad, fertile river bottoms. At that time little effort was made to grow a fine quality of tobacco. The main object was to produce a large yield, hence the rich soils of the bottoms were in demand and the tobacco was used for shipping purposes and for binders and wrappers of cheap cigars. With the changes that came in the character and quality of the leaf demanded by the dealers, the rich first bottoms were given up to a great extent, and now the rolling uplands furnish the best filler leaf grown in the county. Montgomery County easily leads in the amount of tobacco grown in the Miami Valley, as well as in the quality of the leaf. The crop from the entire valley is sold as Montgomery County tobacco.

The fruit industry in Montgomery County deserves mention. Peaches, apples, pears, cherries, and grapes are grown in abundance. Every farm has an apple orchard of a few acres, besides a number of cherry trees and peach trees. Pear orchards are quite common on the uplands, and the pear industry ranks high in the county. Growing peaches for market is also an important industry, while the annual sale of small fruits and garden products amounts to almost $100,000. It will thus be seen that Montgomery County has made considerable progress in the field of agriculture, and well deserves the high rank it occupies.

SOILS.

The soils of Montgomery County are derived from the weathering and modification of the great sheet of glacial drift which was left upon the country. They depend for their crop values largely upon the

proportion of sand and clay they contain, upon their relation to drainage conditions, and upon the relative amounts of organic matter which is incorporated in them. The soils of the county readily fall into two classes, the river-bottom soils and upland soils. The first class is undoubtedly derived from the glacial drift, but this has been so largely modified by stream action that the soils may be put in a separate class from those derived directly from the weathering of the glacial débris or drift.

The soils have approximately the following areas:

Areas of the different soils.

Soils.	Acres.	Per cent.	Soils.	Acres.	Per cent.
Miami clay loam	240,000	78.9	Miami loam	14,000	4.5
Miami gravelly loam	24,000	7.8	Meadow	7,200	2.3
Miami black clay loam	18,000	5.8	Miami sandy loam	4,000	1.1

MIAMI SANDY LOAM.

The Miami sandy loam, as will be seen on the soil map accompanying this report, occupies the smallest area in Montgomery County. It occurs in strips along the river and stream bottoms. The largest area is found along Bear Creek, but there is also a considerable area below Dayton. The latter is the most important of all from the agricultural standpoint. This formation is derived mainly from river wash, and is subject to change from year to year, depending upon the occurrence of floods in the streams along which they occur. The sand represents the ground-up particles of ice-transported bowlders, which occur on the surface of the uplands, mingled with the thick deposits of drift. The areas of Miami sandy loam lie from 6 to 15 feet above the level of the stream beds, so that they are subject to overflow in times of high water.

The soil consists of a brownish or reddish-brown sandy loam to a depth of 24 inches, under which well-rounded, stratified gravel is generally found. In the different areas where these sandy loams are found the size of the sand grains varies somewhat. Generally, it is a rather coarse grade of sand, principally quartz mixed with small amounts of fine and coarse gravel. The amount of gravel on the surface ranges from 10 to 20 per cent, so that it is in sufficient quantity to be a factor in cultivation. These are sandy soils, and although they occupy low positions in stream bottoms they, on account of their sandy nature, are well drained, warm, and dry during the greater part of the growing season. These soils are always spoken of as first-bottom soils, but they do not contain nearly as much organic matter as the Miami loam, which is also a first bottom along the rivers. Along Bear Creek no attempts have been made to grow crops especially adapted to the sandy nature of these soils, but this is not the case in the area south of Dayton

along the Cincinnati pike. The nearness to the city has been taken advantage of, and large quantities of melons, sweet potatoes, cabbage, and other truck crops are annually grown. In all the other areas of this formation corn is the principal crop, and it produces good yields. Some few tobacco fields were observed, but on such soils in a season so well supplied with frequent showers as the season of 1900 the growth is rank, and much difficulty would be experienced in preventing the rapid growth of weeds. In places these soils closely resemble some of the sandy soils of the Connecticut River Valley, on which such a fine quality of wrapper leaf is grown; but the low position of the Miami sandy loam along the rivers rather offsets the sandy character of the soil, and it is doubtful if any great progress could be made in producing other than a medium-grade wrapper leaf.

The following table gives the mechanical analyses of some characteristic samples of Miami sandy loams, soils, and subsoils:

Mechanical analyses of Miami sandy loam.

No.	Locality.	Description.	Organic matter, and loss.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
5002	South of Dayton.....	0 to 10 inches...	2.30	2.90	16.85	34.80	16.05	9.58	11.44	5.30
5000	Liberty, 1 mile SW ..	0 to 12 inches...	4.20	2.68	3.60	13.22	31.20	28.90	8.34	7.00
5001	Subsoil of 5000.....	12 to 36 inches..	3.27	1.88	5.05	19.63	31.72	19.70	9.64	9.84

MIAMI LOAM.

Miami loam occupies a position similar to that of the formation just described, that is, broad, flat terraces situated along the principal rivers and streams of the county. The greatest development of this formation is along the Great Miami, but there are also considerable areas along Stillwater and Mad rivers, as well as on Twin and Wolf creeks. The formation occurs as level or gently rolling terraces about 10 or 20 feet above the river bed. Unless protected by extensive systems of levees, they are subject to overflow during high water, which generally occurs during the spring of the year. The water does not remain so long on the bottom lands as formerly. When the country was first settled it was said that these broad bottoms would be flooded for weeks in the spring of the year. The bottoms were heavily timbered then, and the rivers were filled with obstructions, consisting of masses of logs and driftwood, which prevented the rapid lowering of the streams. Now they are subject to an overflow of several feet, which is probably greater than when the valley was first explored. Then the uplands as well as the valleys were thickly for-

ested and the melting of the winter snows was more gradual, and the rivers consequently rose and fell more slowly than at the present time.

As might be expected, these soils are the deposits of the rivers, thoroughly mixed with decayed organic remains of the luxuriant forest and the undergrowth. From the manner of their formation by the river currents one would suppose that these soils would vary greatly in character in different parts of the valley, but such is not the case. These deposits are much the same in character, whether they occur in the northern or southern part of the county. It is the manner of their origin, during the many floods of the rivers, which accumulates a thick deposit of mixed sand and silt and vegetable refuse, and gives them their great productive value. The soil consists of a rich, black, heavy loam, slightly sandy, but containing sufficient clay to give it the characteristics of a heavy loam. It contains a large amount of organic matter, which gives these soils their dark appearance and lasting fertility. There is but little difference in color between soil and subsoil; often there is no difference in color or texture to a depth of 36 inches. These soils are in places several feet thick, and grade into brownish heavy loams. Although this formation is heavy and poorly drained, the soils are by no means swampy. In dry seasons the surface soil cracks open, often to a depth of several inches. Often there may be small patches where there is a slight admixture of gravel on the surface, but these areas rarely exceed 1 or 2 acres in size. The percentage of gravel in such areas ranges from 10 to 30 per cent. It is well-rounded limestone gravel, with here and there a scattered pebble of some of the hard metamorphic rocks brought by the glaciers from the North. The frequent occurrence of large quantities of small land shells mixed with these soils was also observed.

The texture of typical soils and subsoils is given in the table following:

Mechanical analyses of Miami loam.

No.	Locality.	Description.	Organic matter, and loss.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
5006	West of West Carrollton.	0 to 10 inches...	3.67	1.61	10.25	10.34	20.89	19.07	21.16	12.79
5005	Harshmanville, 1 mile NE.	10 to 30 inches..	11.02	2.46	5.85	6.70	15.30	21.91	30.35	6.32
5007	Subsoil of 5006.....	....do	5.35	2.16	8.08	7.26	22.73	21.73	22.82	9.82

But little timber is found on the Miami loam. There may be a slight fringe along the rivers, but that is all. Sycamore, oak, black

walnut, and hickory constitute the greater part of the present timber growth. As has been noted, these soils were the first to be cultivated, on account of their great natural fertility, and even now for some crops they are the best to be found in the county. Originally they were very strong and produced heavy crops, but now they are considerably worn and yet are really better adapted to general farming purposes. For corn they are ahead of the rest of the county, and from 60 to 90 or even 100 bushels per acre can be raised in a good year. In dry years wheat and timothy can be grown, but when there are frequent rains all crops are apt to be too weedy on these rich bottoms. Many large fields of broom corn are annually grown on the Miami loam soils.

Tobacco was formerly grown to a large extent on the soils of this formation, but with the increasing demands for a better quality this crop has been largely given up. The tobacco is heavy and dark and makes a rank growth, which is undesirable for filler purposes, but answers for shipping tobacco. The old-fashioned broadleaf and seed leaf are the principal varieties of tobacco grown on the first bottoms. The quality of the tobacco is even better than that raised on these same soils many years ago, but the dealers are unwilling to buy tobacco grown on these heavy "black lands," as they are called. In the vicinity of Dayton considerable attention is given to raising melons, vegetables, corn, and celery on the Miami loam. This soil is much in demand for growing corn, but not for general farming purposes, because the streams have a tendency to overflow, which is always considered a detriment even to the finest soils.

MIAMI GRAVELLY LOAM.

Another formation which occupies large areas in the river valleys proper is the Miami gravelly loam. This is generally known as the second bottom, and is considered the finest farming land in the valley. The principal areas are situated between the Great Miami and Mad rivers, and a few miles south of Dayton, east of the Great Miami River in Van Buren Township. There is also another large area in West Dayton, but it is largely covered by the city. In addition to these there are several other areas of a few square miles in extent. This formation may occur as a high first bottom, generally as a second bottom, or it may be a third or even a fourth bottom above the river beds. These river bottoms, or more properly speaking, terraces, are from 30 to 60 feet above the river level. When a number of successive terraces are found they rise from 5 to 15 feet, one above the other. Rarely five distinct terraces may be counted, but the most common occurrence of this formation is either as a high first terrace above the river or a rolling terrace 10 to 15 feet above the areas of the Miami loam formation.

The soils of this formation are derived from the great mass of glacial débris deposited over the country by the ice, but this material

has subsequently been considerably modified by the action of the streams which flow through the valley. These rivers and streams must have been greatly swollen during the close of the glacial epoch when they received the waters from the melting masses of ice from the country to the northward. The terraces certainly bear witness to the assorting and carrying power of these swollen rivers, for in every instance they are found to consist of great thicknesses of well-rounded and nicely assorted beds of gravel and sand. These terraces furnish large stores of gravel well adapted for road ballast, as the many excellent gravel roads of the county will testify. Many of the railroads have also taken advantage of these thick deposits of clean limestone gravel and thousands of cubic yards of this material are used

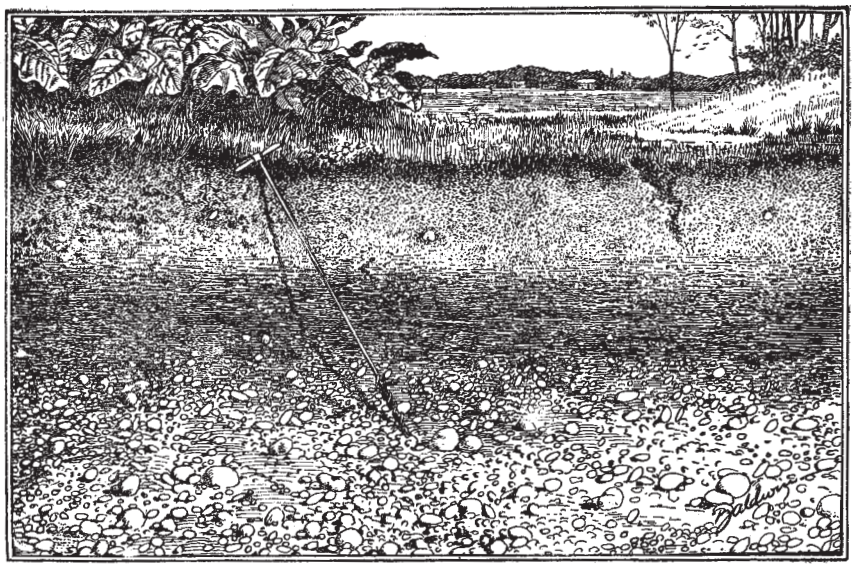


FIG. 5.—Section in Miami gravelly loam, showing loam soil overlying clay subsoil, grading into rounded gravel.

annually for grading their roadbeds. Although the terraces are composed largely of gravel, the soil is more or less mixed with sand and clay. The soil may then be described as a heavy, sticky, reddish-brown loam to a depth of 12 inches. This soil contains some sand, but there is sufficient clay to give it the properties of a heavy loam. Under the soils are found stiff, reddish-brown clay loams, quite similar to the subsoils of the clay uplands, but always containing a larger percentage of sharp angular quartz gravel somewhat less than one-half inch in diameter. The subsoil as we go deeper contains more and more gravel, until at 30 inches it grades into a mass of well-rounded gravel. Exposures of 30, and even 40 feet of well-rounded, stratified gravel underlying these soils were noticed in some of the old gravel pits above and below Dayton. (See fig. 5.) These gravel beds

insure perfect drainage conditions for these soils and render them warm and dry. On the surface there is a varying amount of well-rounded gravel from 2 to 5 inches in diameter. The gravel contained in the soil to a depth of 10 inches is seldom less than 15 per cent, and rarely does it exceed 40 per cent. Excessive amounts of gravel on the surface of these soils are only found in very limited areas. Often along the slopes, from one terrace to another, the gravel may be found coming to the surface in considerable quantities. Generally, the gravel is nearer the surface in the large area south of Dayton than it is in other extensive areas of this formation. None of the areas is subject to overflow from the rivers, even during the highest floods. These soils are variously spoken of as bottom lands, second bottoms, gravel bottoms, and gravel lands.

The mechanical analyses of typical samples are given in the following table:

Mechanical analyses of Miami gravelly loam.

No.	Locality.	Description.	Organic matter, and loss.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
5008	North of Dayton.	0 to 12 inches.....	2.49	5.51	11.23	9.36	17.66	15.58	25.59	12.95
5009	Subsoil of 5008....	12 to 24 inches	2.34	17.64	14.60	10.06	9.90	6.19	13.00	26.53

These second bottoms were eagerly sought by the early settlers, for it was recognized that the soils were light, warm, and dry, and would produce double that of the cold, wet uplands. When discovered they were said to be covered with a thick growth of sugar maple, black walnut, many kinds of oak, ash, hickory, mulberry, elm, locust, buckeye, basswood, sycamore, cherry, hackberry, gum, and beech—trees which denote a rich, productive soil. But little now remains of the once extensive forest growth, and only scattered wood lots are seen which are mostly a growth of a few varieties of oak.

Corn, wheat, and tobacco are the principal crops, and, in addition, considerable truck is grown near Dayton on these loamy second bottoms. From 50 to 60 bushels of shelled corn per acre can be grown, and from 20 to 30 bushels of wheat is a good yield. In a favorable season clover does well, and considerable sorghum cane is raised in different parts of the valley. Many large market gardens are successfully operated near Dayton. These usually have two or more large windmills for pumping water to irrigate the small fields, and to enrich the soil large amounts of stable manure are brought from the city. The main truck crops are celery, cabbage, melons, tomatoes,

beans, corn, together with small fruits and grapes. The soils of this formation are always in demand, and some of the best improved farms of the county are to be found on the gently rolling terraces. It was on these soils that the early cultivation of tobacco received such an impetus, and for a long time they were considered the finest tobacco lands of the valley, but with the ever changing demands of the trade they are not now so important as formerly. There are many large fields of tobacco raised each year, although the quality of the leaf does not compare with that grown on the clay uplands. Many assert that the crops grown on "gravel land" has a decided tendency to rust badly, but fully as many tobacco growers maintain that such is not the case. Nevertheless, for some reason, tobacco grown on any character of bottom land, whether gravelly or not, is subject to rust and does not make as desirable a filler leaf as that grown on the uplands.

MIAMI CLAY LOAM.

We have now come to the most important soil formation in the county—the Miami clay loam. This formation covers fully four times as large an area in the county as the combined areas of all the other formations, and if time had allowed the survey to be extended into adjoining counties a still greater extension of this same formation would have been found reaching for miles and miles in every direction. Frequently the roads extend a long distance through this formation without a change in the character of the soil, other than the slight changes depending upon the varying drainage conditions of the different fields. There are large areas in the northern part of the county that are the exact counterparts of equally large areas in the extreme southeastern or southwestern portions of the county.

The surface of this formation varies greatly in the different sections of the county. In the northern and central portions the formation is a broad, level, or gently rolling plain. In the other sections the surface is hilly and broken, although there are frequently interstream areas which are comparatively level for a considerable distance. In the level areas of this formation the fields are apt to be poorly drained, and formerly this was much more generally the case, but the opening of large ditches and the drainage of the fields by tile drains have put the lands in excellent condition, so that they are no longer spoken of as cold wet uplands. In the more hilly portions the drainage is well established and artificial drainage is unnecessary. Where the upland borders the valleys often there is a steep scarp of from 80 to 120 feet, but where the valleys gradually merge into the uplands a distance of several miles may be traversed before the general level of the upland is reached.

These soils are the weathered products of the heterogeneous mass of ground-up rocks which were left upon the surface of the county in

Glacial times. This deposit of Glacial debris varies from a few feet in thickness to upward of 100 feet, depending upon the inequalities of the original rock surface before the materials were deposited.

The soil proper of this formation may be classed as a light loam, uniform in texture and composition. It is a remarkably uniform soil, and is everywhere seen to be the same, whether found on the steep hillside or on the more level upland. It has a light, brownish-yellow color when newly plowed or when moistened by recent rains. When not stirred for several weeks in a hot, dry season it becomes almost white, and is often spoken of by the farmers as white clay. This character of material is found to an average depth of 10 or 12 inches. It is easy to till, as it is light and loose and readily dries after rains. The

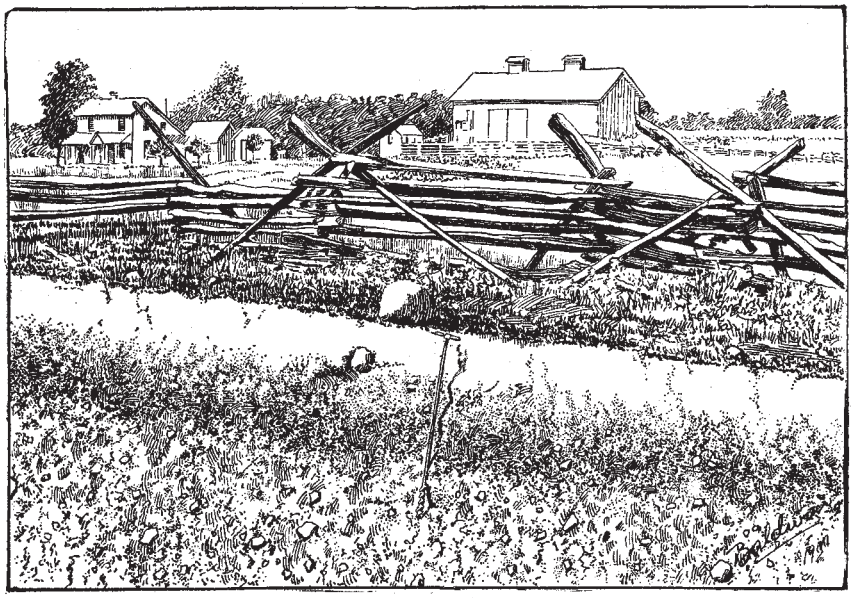


FIG. 6.—Section in Miami clay loam, showing light loam soil on stiff clay loam, grading into bowlder clay.

subsoil, beginning at a depth of 12 inches, is a heavy, sticky, red-brown clay loam which, when thoroughly dried, checks into small cubes closely resembling the stiff subsoils of the Miami gravel loam. The clay loam subsoil contain a much smaller percentage of small, angular quartz gravel, and in many localities it contains no gravel whatever. When these clay subsoils are free from gravel they closely resemble the alluvial deposits of the Red River in Louisiana and Arkansas. The depth of the clay subsoils of this formation is from 2 to 5 feet. (See fig. 6.) In the northern and in some places in the central western portions of the county the clay subsoils rest directly upon the glaciated and scratched surface of the Niagara limestones. In many other portions the subsoil at a depth of 3 or 4 feet passes gradually into a stiff

mass of clay filled with angular bowlders and pebbles and with occasional pockets of quartz sand and well-rounded, clearly stratified gravel. The pebbles and bowlders interbedded in the ground mass of clay generally have sharp corners and are often scratched, especially on one side. Exposures of this drab-colored mass of bowlder clay, as it is called by geologists, were noticed which had a thickness of 40 feet; again, at a depth of 18 or 20 feet, it was observed resting upon a bowlder clay somewhat similar to that in composition, but of a decidedly bluish color and with a slightly greater percentage of clay. There is usually a small amount of stones on the surface of the soils, but never enough to interfere with cultivation, for the bowlders above described have long been removed or so placed that the fields can be cultivated without great difficulty. The percentage of small stones on the surface varies from 5 to 20 per cent. These stones are fragments of limestone and angular pieces of the metamorphic series of rocks, such as granite, gneiss, etc.

The mechanical analyses of a number of soils and subsoils are given in the following table:

Mechanical analyses of Miami clay loam.

No.	Locality.	Description.	Organic matter, and loss.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
5014	Centerville, 2 miles SE.	0 to 12 inches.....	2.68	0.72	1.57	1.78	4.08	10.82	65.80	11.62
5012	Salem, one-half mile SW.	Brown loam, 0 to 12 inches.	3.86	1.28	2.83	3.46	11.36	11.40	48.40	16.89
5013	Subsoil of 5012.....	Stiff clay loam, 12 to 36 inches.	2.84	2.72	3.52	3.34	11.19	14.22	26.40	35.25
5017	Sulphur Grove, 1 mile E.	12 to 36 inches ..	3.12	1.31	2.49	2.49	8.64	13.11	31.11	37.37

Although it has been stated that these soils are remarkably uniform, there are two areas which deserve special attention. These are a high hilly area a short distance southeast of Dayton, and another somewhat similar area a few miles northwest of Dayton, in Harrison Township. In these two localities there are several high hills which are composed to a great extent of large, rounded gravel filled with pockets of clean sharp sand and overlaid with soils, the exact counterpart of the soils of the typical areas of this formation. The only difference in these areas is that at a depth of 2 feet the subsoils are underlaid with gravel instead of a compact clay filled with angular bowlders. The drainage conditions of these two areas are the same as the Miami gravelly loam.

The Miami clay loam is called by various local names, which usually have some reference to the topography or soil conditions. A

common name is that of "sugar-tree land," on account of the prevalence of the sugar maple in the native forests. Again, they are called clay uplands or second bottoms, as distinguished from the lower river bottoms proper. Frequently they are called limestone soils, from the beds of limestone which closely underlie them; again they are called white clays, or, if deep plowing has brought some of the subsoil to the surface, they are termed red clays. In the more level portions of the area, where the timber growth is largely beach, the name beech land is used. When these lands were first explored they were covered with a thick growth of sugar and soft maple, basswood, beech, black walnut, poplar, wild cherry, white and blue ash, several varieties of oak, black gum, elm, hickory, buckeye, and ironwood. There is still considerable timber standing on the uplands which can be seen skirting the horizon in every direction. From an eighth to a tenth of the entire area is still forested with the clean open forests characteristic of this section of Ohio. Almost every farm has a few acres of woodland which are used as pasture for the cattle and from which the supply of firewood is obtained. When the woods consist largely of sugar trees, the sugar house is generally found somewhere within its borders, and in the spring a good profit is realized from the sale of the maple sirup or maple sugar made from the evaporated sap.

While the Miami clay loam is not the most fertile soil found in the county, still it is good strong land, capable of being made very productive, and is durable and lasting. It will produce on an average from 40 to 60 bushels of corn per acre, but a yield of 75 or 80 bushels is not uncommon. Wheat will make from 20 to 30 bushels, but in 1900, owing to unfavorable conditions, the crop was a complete failure, there being very few farmers who even recovered their seed wheat. Oats do well on these soils, while clover and timothy make fair crops, but are not extensively raised. In the rotation practiced, corn is usually followed by wheat with clover sown in the spring; the following spring the clover is used for hay, and this is in turn followed by corn. This is the usual three-year rotation, but other rotations may vary somewhat, depending upon the number and size of the fields in the farm. When tobacco is grown it usually follows the corn crop. Considerable millet is grown on the uplands, but it is generally grown as a catch crop when other crops for some reason have failed. Many fields of sorghum cane are grown on the uplands, and it is generally considered that the crop does very well. Fruits also make a fine growth on the clay uplands, and every farmer has a small apple orchard and a few pear trees and cherry trees. Occasionally peach orchards are seen, but they are not generally successful on the more level uplands.

Tobacco is the one crop which seems to succeed the best of all on the clay loams of the uplands, and each year large quantities are harvested. On almost every farm will be found 3, 5, or 8 acres of tobacco, while many farmers have from 10 to 30 acres in this crop. Tobacco

grown on the uplands has good body, good sweating properties, is fine fibered, and elastic.

MIAMI BLACK-CLAY LOAM.

Like the soils of the formation just described, the Miami black clay loam is found occupying portions of the upland. The largest continuous areas are in Clay Township, in the northwestern part of the county, but there is no township which does not contain several small scattered areas of this formation. These areas are always found more extensively developed in the more level portions, and it is the level or gently rolling character of the county which accounts for their occurrence. Upon close examination, they are found to occupy small depressions on the surface of the upland. When the ice retreated northward, at the close of the glacial epoch, these small depressions on the surface of the drift were gradually filled with standing water. The accumulation of decaying vegetable matter and the slight wash from higher ground has formed the soils of the Miami black clay loam. The soils, then, of this formation are the result of the imperfect drainage conditions of these old depressions on the surface of the glacial débris of ground-up rock and clay or drift. When the country was discovered many of the areas of this formation were covered with several feet of water, which did not drain off the entire year. Mention is made[1] of one of these swamps in Butler Township, which was thickly covered with trees. In this swamp large flocks of wild ducks and geese were swimming about. Other swamps are mentioned, which were regular peat deposits and quagmires. All of these wet lands were held in low esteem. Since that time they have been thoroughly drained by deep wide ditches and by field drains of various sorts, until now they are capable of cultivation and are perfectly dry, but little evidence remaining of their former swampy condition.

The soils of this formation are easily recognized by their black color, which in dry seasons become somewhat ashy. The top soil consists of a heavy, black, sticky clay loam, which is hard to cultivate on account of its clayey nature. The soil has a tendency to bake hard and to crack open in dry seasons. Often there is no change in the character of these soils to a depth of 2 feet; again, the subsoil may be a trifle heavier and more tenacious. At a depth of 3 or 4 feet, or occasionally at a less depth, they grade into stiff yellowish clay loam. This is undoubtedly the same material as the subsoils just described, only the amount of organic matter is somewhat less, and the soils are hence less discolored. At greater depths than 3 or 4 feet the subsoils are the same as those of the Miami clay loam. There is a slight admixture of angular stones and pebbles upon the surface, but the amount seldom exceeds 20 per cent.

The following table contains mechanical analyses of typical samples of both soils and subsoils of this formation.

[1] History of Montgomery County, Ohio, 1883.

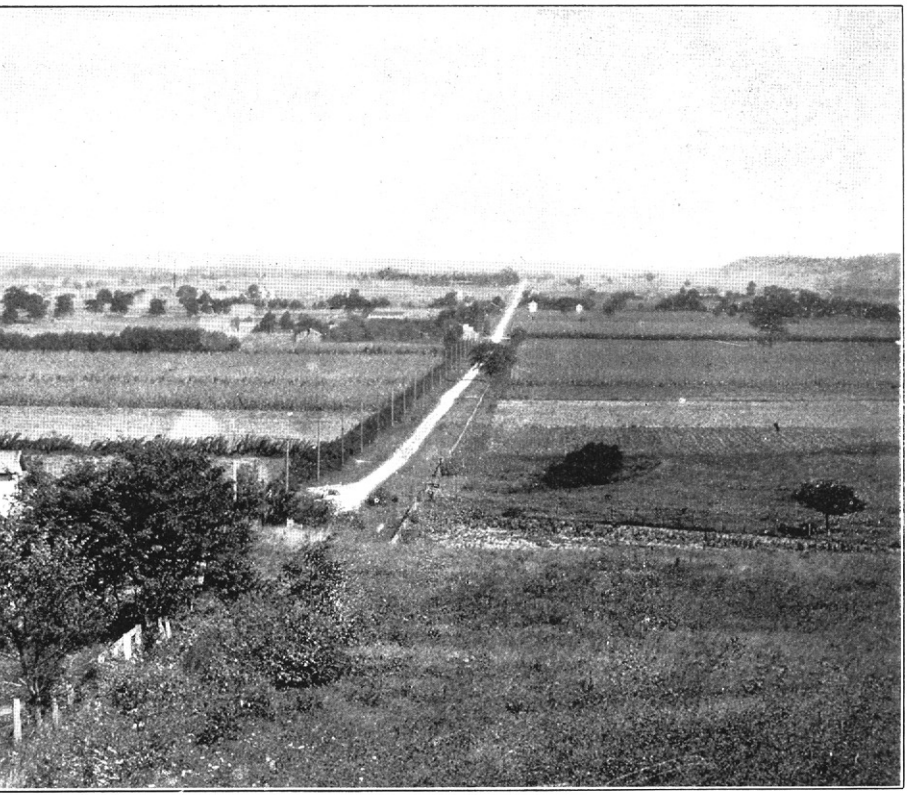
Mechanical analyses of Miami black clay loam.

No.	Locality.	Description.	Organic matter, and loss.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
5023	Stringtown, 2 miles E.	Heavy black loam, 0 to 12 inches.	8.93	.46	2.19	2.38	6.16	9.30	54.43	15.30
5021	West Baltimore, one-half mile N.	Heavy loam, 0 to 10 inches.	6.86	1.40	2.14	2.69	7.34	8.29	54.14	17.14
5024	Subsoil of 5023	12 to 36 inches	5.67	.74	2.30	2.15	6.38	7.52	53.31	22.29
5022	Subsoil of 5021	Black clay loam, 10 to 36 inches.	4.87	.72	1.94	1.56	4.87	7.56	52.52	25.90

Originally these areas were covered with a heavy forest growth, consisting of much the same growth as that found on the Miami clay loam. Walnut, beech, and elm were much more abundantly found. Before drainage, many of these places were miry and were carefully avoided, but now they are all cultivated and are fairly productive. They make good crops of corn and tobacco, but clover does not succeed well nor does wheat, which puts on too heavy a growth of straw and is apt to lodge. The yield of the various crops on these soils is not essentially different from that of the Miami clay loam in favorable years. Good crops of tobacco are also grown on these soils after they have been cropped a few years. It is said that when these soils are fresh the tobacco is apt to fire in a dry season and be rank and coarse. In good seasons crops are grown that will compare very favorably with the best of the clay upland tobacco. It is said that where the areas of these black clay soils come in contact with the yellow clay loam soils the mixture of the two soils will produce a fine quality of Zimmer Spanish tobacco. Although the areas of this formation were considered very poor, on account of their imperfect drainage, they now rank as productive soils and command a fair price. They are called black lands and bottom lands, although they probably occupy the highest portions of the county.

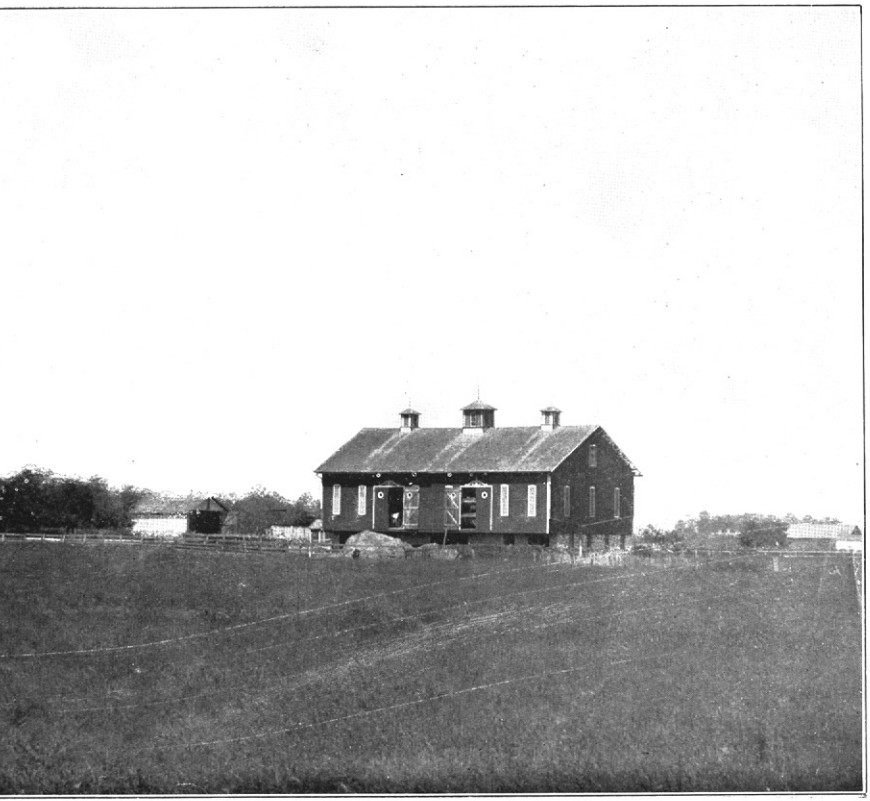
MEADOW.

This name has been used to describe a condition of the soils very generally noticed in the county, rather than any particular type of soil. Usually occurring in narrow strips along the small streams, they are seldom over a few hundred yards in width. Wherever the stream valley widens out considerably and is characterized by a certain definite character of soil, the soil is classified and the area shown on the map, but the meadows are the smaller stream bottoms, wet and swampy, and uncultivated. Generally, the soils of the meadows are sandy and mixed with decomposed matter, and if thoroughly drained would make fertile land, but in their present condition they are used for pasture, or occasional crops of meadow grass may be cut off them. If drained they would produce good crops of corn and also good crops of timothy hay.



W OF SECOND BOTTOM LAND (MIAMI GRAVELLY LOAM) SOUTH OF DAYTON.

MIAMI GRAVELLY LOAM WITH MIAMI CLAY UPLAND IN DISTANCE.



GROUP OF FARM BUILDINGS ON MIAMI CLAY LOAM.

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U.S. DEPT. OF AGRICULTURE
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MILTON WHITNEY, CHIEF.

SOIL MAP

OHIO
MONTGOMERY CO SHEET

SOIL PROFILE
(3 feet deep)

Miami sandy loam — Ssc / Sc
Miami loam — Sc / Sc
Miami gravelly loam — Sc / Gr / Scc / Gr
Miami clay loam — Sc / Scc
Miami black clay loam — Scc / Scc
Meadow — Ssc / Sc

LEGEND

Ssc Sandy loam
Sc Loam
Scc Clay loam
Sg Gravel loam
Gr Gravel

LEGEND

Mcl Miami sandy loam
Ml Miami loam
Mgl Miami gravelly loam
Mcl Miami clay loam
Mbl Miami black clay loam
M Meadow

Soils Surveyed by
Clarence W. Dorsey and
Geo. N. Coffey
1900

Scale 1 in = 1 mile

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